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RADIUM

A MONTHLY JOURNAL DEVOTED TO THE CHEMISTRY, PHYSICS AND THERAPEUTICS OF RADIUM AND OTHER RADIO-ACTIVE SUBSTANCES

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VOL. II JANUARY, 1914 NO. 4

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ACADEMY OF MEDICINE,
TORONTO.
QUEEN'S PARK

RADIUM

A MONTHLY JOURNAL DEVOTED TO THE CHEMISTRY, PHYSICS AND THERAPEUTICS OF RADIUM AND OTHER RADIO-ACTIVE SUBSTANCES

PUBLISHED BY THE RADIUM PUBLISHING COMPANY
FORBES AND MEYRAN AVENUES, PITTSBURGH, PA.

We shall be glad to receive for publication from our subscribers and readers articles pertaining to the subject of radium and its application. All inquiries for information will be accorded prompt attention, and will be answered either by letter or through the columns of this paper.

VOL. II JANUARY, 1914 No. 4

THE INTRAVENOUS INJECTION OF SOLUBLE RADIUM SALTS.

By FREDERICK PROESCHER, M. D.

Director of the Laboratory for Experimental Therapy, Standard Chemical Company.

In a preliminary communication in this Journal* I reported, in brief, the result of the intravenous injection of soluble radium salts in human beings—a procedure heretofore never attempted with such large dosage. The results obtained encouraged me to further investigation and I selected a series of cases which are favorably influenced by the direct radium emanation method. As I have already stated the intravenous method has a decided advantage over the present method of administration in that it can be given by the general practitioner, and also reduces the length of time necessary to obtain a result—a matter of considerable importance to the patient.

The concentration of radium emanation introduced into the organism is, because of many factors, not always constant and it is exhaled in time; the emanation soon passing from the body through the lungs, and the active deposit of radium A, B and C soon decaying to form the rayless radium D.

When soluble radium salts are injected intravenously, the radium is carried through the body and deposits in the form of carbonate and sulfate. The radium is to a small extent excreted in the urine and feces, the greater portion, however, being deposited in the bone marrow. We therefore render the organism not only passively but actively radioactive for a considerable period and, what is more important, the action is constant. In other words, the body becomes a vital emanatorium due to the deposit of radium salts.

At present, we can safely say that radium salts introduced intravenously (in a quantity up to one milligram radium element) are per-

*The Intravenous Injection of Soluble Radium Salts in Man. Radium Vol. 1, No. 4, July 1913.

fectly harmless. Thirty patients given one, and sometimes several injections, did not show the slightest alarming symptom or any injurious effect to any organ. This observation extended over a period of from three to six months.

One hundred to two hundred micrograms of radium (element), or smaller doses of ten to fifty micrograms, (given at once or in repeated doses) were administered by me for therapeutic purposes. However, I am inclined to believe that, with further experience, even much larger doses could be safely given.

The technic of the injection was the same as described in my previous communication. Radium in the form of chloride or bromide, dissolved in sterile physiological salt solution sealed in glass ampulles was used. The injections were given by means of a glass syringe without rubber attachment, the injection being made into the cephalic vein.

The following cases have been treated:–

Polyarthritis and Oligoarthritis	16
Pernicious Anemia	1
Leukemia	1
High Blood Pressure	8
Tabes Dorsalis	1
Epilepsy	1
Multiple Sclerosis	2

At this time I wish to submit reports on the 16 cases of arthritis.

CASE NO. 1. MALE; AGE 28 YEARS. LABORER.

Previous History.—Negative.

Present History.—On May 23, 1913, patient contracted a severe cold and the following day he felt feverish and weak, and this condition became worse during the next 24 hours. On May 26th he complained of pain in back and neck. Three days later his knees and ankles began to swell and were tender and painful and he was unable to get out of bed, and was removed to the hospital.

Objective Symptoms.—Knees and ankles swollen and very painful.

Diagnosis.—Acute polyarthritis.

Course of Illness After Injection of Radium.—6-11-1913. Patient given 10 micrograms radium (element) intravenously.

6-12-13. All joints more or less tender and stiff and slightly swollen.

6-13-13. Pain has left all joints except shoulders which are still stiff. 10 micrograms radium (element) injected intravenously.

6-14-13. Joints less swollen and painful. 20 micrograms of radium (element) injected intravenously.

6-15-13. All joints stiff, no pain.

6-16-13. General condition good, joints still stiff, swelling in knees and ankles disappeared.

6-17-13. 20 micrograms of radium (element) injected intravenously.

6-25-13. Slight stiffness in both knee joints, but able to walk. 10 micrograms radium (element) injected intravenously.

6-26-13. Complains of a slight stiffness in both hands. Sleeps very well. No pain in knee and ankles.

6-28-13. Feels generally very good, no pain in joints. Discharged from hospital.

Final examination, October 23, had no recurrence since May. General condition very good. Result—Temporarily cured.

CASE NO. 2. MALE: AGE 21 YEARS. ELECTRICIAN.

Previous History.—Patient had his first attack of rheumatism in 1909. The knees, ankles and at times the hands were involved.

Present History.—In the latter part of June, 1913, the patient was suddenly incapacitated by pain and swelling involving knees and ankles. He was unable to move about and was confined to his bed. His condition was complicated by an endocarditis with mitral systolic murmur.

Objective Symptoms.—Swelling of knees and ankles.

Diagnosis.—Chronic progressive polyarthritis complicated by endocarditis.

Course of Illness After Injection of Radium.—7-3-13. Patient given 100 micrograms radium (element) intravenously.

7-4-13. Moderate pain in both knee articulations and some slight pain in all articulations. Both knee articulations swollen.

7-5-13. No pain in articulations.

7-7-13. Stiffness in knee, shoulder and elbow articulations.

7-8-13. Swelling of both knee articulations entirely disappeared. General condition, improved.

7-10-13. Slight tenderness in both knee articulations, elbows not swollen.

7-15-13. Patient feels better. Able to walk.

10-19-13. Final examination. He has had no return of rheumatic symptoms. Is feeling very well. Result—Temporarily cured.

CASE NO. 3. MALE: AGE 36 YEARS. CARPENTER.

Previous History. First attack of rheumatism April 1st, 1913. All articulations were involved. Patient had taken salicylates during the entire course of his illness.

Present History.—All articulations are involved to a greater or less degree. Ankles are very painful and swell intermittently.

Objective Symptoms.—All articulations are more or less swollen and tender to the touch.

Diagnosis.—Chronic polyarthritis.

Course of Illness After Injection of Radium.—7-2-13. Patient given injection of 100 micrograms of radium (element) intravenously.

7-3-13. All articulations are stiff and tender to touch.

7-4-13. Patient walks much better. Feels better than he has for a long time. Voids freely.

7-7-13. Patient has no pain. Walks better. His general condition is good. Patient, by chance, having been caught in a rain storm, had his feet dampened. He has had no return of rheumatic trouble since. This would seem to indicate much improvement in his general condition, especially in reference to his rheumatic diathesis.

8-1-13. General condition, very good. All articulations appear normal. Is able to get about as usual.

11-3-13. Both ankles sore and swollen. Patient unable to walk and cannot wear high shoes. Both arms from hand joints to elbow tender but no swelling. General condition good. 50 micrograms of radium (element) injected intravenously.

11-5-13. Two days after the radium injection, swelling of ankles and tenderness of both arms disappeared. Able to walk. Result—Considerably improved.

CASE NO. 4. FEMALE: AGE 26 YEARS. HOUSEWIFE.

Previous History.—Negative.

Present History.—Patient complains of pain in left foot and ankle since the middle of May, 1913. Pain more exaggerated when walking.

Objective Symptoms.—Left foot and ankle swollen. Cannot wear high walking shoes.

Diagnosis.—Subacute polyarthritis.

Course of Illness After Injection of Radium.—7-3-13. Intravenous injection of 100 micrograms of radium (element).

7-4-13. Left foot swollen and painful; more or less pain in all articulations.

7-9-13. Swelling of left foot reduced.

7-10-13. Intravenous injection of 100 micrograms of radium (element).

7-11-13. Subsidence of swelling of the left foot.

7-12-13. Swelling of foot almost gone. No pain.

7-14-13. Ankle slightly swollen; some pain but can wear shoes.

7-23-13. Is now able to wear shoes. Ankle slightly tender to touch.

8-25-13. Swelling subsided permanently. Has not had reappearance since. Is now able to wear shoes comfortably. Result—Temporarily cured.

CASE NO. 5. FEMALE; AGE 39 YEARS. DOMESTIC.

Previous History.—Patient had an attack of tonsilitis in 1907. In May, 1912, patient was stricken with pain and swelling in both shoulders, elbows, knees, ankles and fingers.

Objective Symptoms.—Fingers of both hands are swollen and painful; patient cannot close her hands.

Diagnosis.—Chronic progressive polyarthritis.

Course of Illness After Injection of Radium.—7-6-13. Patient given 100 micrograms of radium (element) intravenously.

7-6-13. Both elbow and finger articulations are painful and swollen.

7-9-13. Both wrists and finger articulations are less painful.

7-10-13. Both wrist articulations are less painful; swelling is subsiding.

7-11-13. During night both ext. malleoli are very tender to the touch and very painful. No pain in wrist articulations.

7-12-13. Patient feels better; pain absent in both hands and ankles.

7-17-13. No pain in ankles; walks very well. Hands slightly swollen but not painful; patient sleeps well. General condition much improved.

7-20-13. Patient had a recurrence of pain in hand, elbow and left shoulder. Ankle not painful but slightly stiff when walking.

7-21-13. Both feet very painful, as is also right shoulder.

7-22-13. Some stiffness in all articulations when attempting to move about.

7-23-13. Patient feels apparently well; has no pain in articulations, but some slight stiffness when attempting to move the various articulations.

8-5-13. Patient had a relapse affecting hands and ankles.

8-5-13. Patient given 50 micrograms of radium (element) intravenously. Patient did not return after the last injection. Result—Improved.

CASE NO. 6. MALE; AGE 36 YEARS. CARPENTER.

Previous History.—Patient was stricken with his first attack of rheumatism about 15 years ago, being confined then to his bed for a long period.

Present History.—On May 20th, 1913, he was suddenly stricken and incapacitated by an attack of rheumatism involving his limbs. For a period of three weeks all the articulations were affected and patient was hardly able to move his limbs.

Objective Symptoms.—Both shoulder articulations slightly swollen and tender to touch and painful on movement. Cannot use his shoulder articulations. Both ankles are swollen and painful on movement.

Diagnosis.—Chronic progressive polyarthritis.

Course of Illness After Injection of Radium.—7-3-13. Patient given 100 micrograms of radium (element) intravenously.

7-4-13. There is a general stiffness of all articulations. Left ankle and left knee articulations slightly painful when attempting to use them. Slept very well.

7-5-13. Patient is relieved of pain for the first time since May 20th, 1913. Feels generally improved. Stiffness in articulations less marked.

7-7-13. Some pain in both shoulder articulations. Otherwise feeling very comfortable.

7-8-13. Pain in right shoulder articulation. Patient given 50 micrograms radium (element) intravenously.

7-10-13. Condition unchanged. Patient given 50 micrograms radium (element) intravenously.

7-12-13. Right shoulder still impaired.

7-14-13. No pain but slight stiffness in both shoulder articulations. Slept very well. Was able to dress himself for the first time since May 20th, 1913.

7-17-13. Feels good. No pain in articulations. Shoulder somewhat stiffened.

7-21-13. Pain in both feet. Planta pedis very tender. Walks with difficulty. Pain in both shoulders. Right elbow very painful and tender.

7-28-13. Pain still continued in right shoulder articulation. Biceps muscle very painful and tender. Unable to raise both arms owing to adhesions in both shoulder articulations. Result—Considerably improved.

CASE NO. 7. FEMALE; AGE 23 YEARS. DOMESTIC.

Previous History.—Patient developed an attack of acute rheumatism which confined her to bed for a period of 18 weeks during 1909. Both knees and hands were involved. Patient has never been entirely free of rheumatism since her first attack.

Present History.—Knee, hand, finger, shoulder and elbow articulations are very painful and tender to touch. Cannot walk and has to be carried around in a chair.

Objective Symptoms.—Both knees enlarged and patient unable to walk. All phalangeal articulations are spindle shaped, swollen and deformed.

Diagnosis.—Oligoarthritis deformans.

Course of Illness After Injection of Radium.—7-8-13. Patient given 100 micrograms of radium (element) intravenously.

7-9-13. No reaction in articulations. Slight rise of temperature about one degree above the normal.

7-20-13. Pain in all articulations; more painful in left wrist. Left wrist swollen.

7-21-13. All articulations are stiff but not as tender to the touch as originally. Patient sleeps well.

7-24-13. Pain still continues in all articulations. Feels generally in decline.

7-28-13. Some slight improvement in condition. Articulations still painful.

8-2-13. Patient feels much improved. Tenderness of articulations have almost disappeared. Sleeps well.

8-25-13. 250 micrograms radium (element) given intravenously.

8-28-13. Reaction in all articulations with tenderness.

9-5-13. No improvement noted.

11-28-13. Final examination. Result—Not improved.

CASE NO. 8. MALE; AGE 74 YEARS. PLAYWRIGHT.

Previous History.—Patient has his first attack of rheumatism at the age of 55, continuing then for a period of six consecutive months, involving all articulations.

Had similar attack five years ago. Complained of having painful knees but no swelling. Later, during the course of this attack, shoulders and elbows of both arms became involved, also both hands.

Objective Symptoms.—Phalangeal articulations are deformed and ankylosed. On the second metacarpal-phalangeal articulation there appears a movable nodule the size of a cherry, which is not painful on pressure and apparently never appears red. On the olecranon processes of both elbow articulations there appears a nodule the size of a plum, easily movable and at no time inflamed.

Diagnosis.—Oligoarthritis deformans.

Course of Illness After Injection of Radium.—7-19-13. 100 micrograms of radium (element) given intravenously.

7-21-13. Slight reaction in all articulations. Feels a general stiffness and has aching of the muscles and bones throughout his body.

7-23-13. Less pain in all articulations. Feels generally improved.

8-5-13. No pain in articulations but general health poor.

Patient given 30 micrograms of radium (element) intravenously.

11-7-13. Final examination. Result—Not improved.

CASE NO. 9. FEMALE; AGE 50 YEARS. HOUSEWIFE.

Previous History.—Negative.

Present History.—About January 1, 1913, patient suddenly developed an inflammatory process affecting the 3rd finger of the right hand and also the thumb of the left. Process continued almost a week. The articulations of both hands and the muscles of both arms became swollen and very painful.

Objective Symptoms.—The 3rd finger of the right hand and the thumb of left were swollen, movements of finger and wrist articulations are impaired.

Diagnosis.—Chronic progressive polyarthritis.

Course of Illness After Injection of Radium.—7-5-13. Intravenous injection of 100 micrograms of radium (element).

7-7-13. Affected finger articulation and backs of both hands are swollen and painful.

7-8-13. Finger articulations less swollen and more movable.

7-10-13. Finger articulation somewhat tender minus pain. Swelling seems to be reduced.

7-12-13. Finger articulation in about a similar condition as on the 10th day.

7-18-13. Swelling of both hands and finger articulations reduced. Feels generally improved.

8-5-13. Final examination. Feels generally improved. Swelling of fingers and hand disappeared. Result—Considerably improved.

CASE NO. 10. FEMALE; AGE 43 YEARS. HOUSEWIFE.

Previous History.—Patient had her first attack of rheumatism in 1904, which affected the fingers of both hands. Later developed the same condition in all articulations.

Present History.—Patient is suffering for the past ten weeks with pain and swelling of both knee articulations, and is confined to her bed most of the time.

Objective Symptoms.—Can hardly walk; both knees painfully stiff and crepitating when attempting to move.

Diagnosis.—Chronic progressive polyarthritis.

Course of Illness After Injection of Radium.—7-14-13. 100 micrograms of radium (element) given intravenously.

7-15-13. Knee articulations very stiff but not painful; slept well; better than usual.

7-17-13. Slight soreness in knees; better able to ambulate.

7-21-13. Knees somewhat stiff but not painful; rests very well at night. 50 micrograms radium (element) given intravenously.

Final Examination.—Since having taken treatment with radium, patient seems better than formerly. Has no pain in knee articulations, but articulations are stiff and painful. Result—Considerably improved.

CASE NO. 11. MALE; AGE 43 YEARS. LABORER.

Previous History.—Patient had his first attack of polyarthritis 10 years ago. He was then sick for 9 consecutive months. Right hip articulation was involved. Occasionally other articulations became involved.

Present History.—Constant pain in right hip articulation when ambulating.

Objective Symptoms.—Negative.

Diagnosis.—Chronic progressive polyarthritis.

Course of Illness After Injection of Radium.—7-8-13. 100 micrograms of radium (element) given intravenously.

7-9-13. Pain in right hip articulation. General stiffness of muscles.

7-10-13. Able to walk. No pain.

7-13-13. Has pain in right hip articulation.

7-17-13. No pain in right hip articulation.

7-21-13. Pain in right hip and left knee articulations. 50 micrograms of radium (element) given intravenously.

7-26-13. Left leg very painful. Right thumb swollen and painful. Pain absent in right hip articulation.

7-28-13. Slight pain in all articulations. Knee articulations, slightly stiff. No pain in right hip articulation. Result—Considerably improved.

CASE NO. 12. FEMALE; AGE 48 YEARS. DOMESTIC.

Previous History.—Negative.

Present History.—Patient is suffering with severe pain in all her articulations for the past year and a half and has been confined to the hospital for that period.

Objective Symptoms.—Examination reveals both knee articulations to be swollen and tender to the touch, crepitation being present when moving same. The fingers of both hands are involved to the extent that she is unable to close them tightly.

Diagnosis.—Chronic progressive polyarthritis.

Course of Illness After Injection of Radium.—8-11-13. Patient given 50 micrograms of radium (element) intravenously.

8-13-13. Stiffness in fingers of both hands and ankles and also of muscles of the lumbar region.

8-15-13. Slight pain in the muscles covering the sacral region. Some pain in the phalangeal articulations of both hands and also the right knee articulation.

8-16-13. Pain on the dorsal aspect of the right hand and in the first metacarpo-phalangeal articulation.

8-18-13. Pain in shoulders, arms and in the region of the sacrum.

8-20-13. Pain in right hand and right knee articulation. Patient given 100 micrograms of radium (element) intravenously.

8-21-13. Slight pain in the sacral region.

8-22-13. Some slight pain in both shoulder articulations.

8-23-13. Final examination. Patient has pain in the back. Pain in the sacrum and right shoulder have disappeared. Feels generally better. Result—Considerably improved.

CASE NO. 13. MALE; AGE 50 YEARS. LABORER.

Previous History.—Patient had chronic rheumatism for the past nine years involving both elbow and shoulder articulations.

Present History.—He has been unable to follow his occupation for the past five years and at times was compelled to take to bed in the hospital, being incapacitated for weeks.

Objective Symptoms.—Both elbow articulations are tender and painful to the touch and when attempting to move them are painful and crepitate. There is wasting of muscles of the shoulders, partial inability to raise the arms and also partial inability to flex or extend same.

Diagnosis.—Oligoarthritis deformans.

Course of Illness After Injection of Radium.—8-13-13. 100 micrograms of radium (element) given intravenously.

8-14-13. Pain in both elbows.

8-15-13. Pain in both elbows. Not much improvement.

8-16-13. Patient feels generally much better. Has some slight pain in right elbow.

8-19-13. General condition about the same.

10-11-13. Very slight improvement in elbow articulations.

12-4-13. Final examination. Marked improvement in both elbow articulations. Able to shave and wash himself. Result—Considerably improved.

CASE NO. 14. FEMALE; AGE 44 YEARS. DOMESTIC.

Previous History. Patient was taken sick about six months ago with pain involving all articulations and she was obliged to remain in bed for a period of ten weeks. Had an attack of sore throat occasionally.

Present History.—Patient walks with difficulty and has pain in both knees when ambulating.

Objective Symptoms.—Both knees enlarged with crepitation on movement.

Diagnosis.—Chronic progressive polyarthritis.

Course of Illness After Injection of Radium.—8-11-13. Intravenous injection of 100 micrograms of radium (element).

8-12-13. Both knees very stiff.

8-14-13. Slight improvement in stiffness of left knee.

8-16-13. Patient feels apparently better; walks better than formerly.

8-20-13. Intravenous injection of 100 micrograms of radium (element).

8-21-13. No pain in knees.

8-22-13. Swelling disappeared, markedly improved.

9-25-13. Final examination. Apparently improved but has occasional slight twinging in right knee articulation. Result—Improved.

CASE NO. 15. MALE; AGE 55 YEARS. STONEMASON.

Previous History.—Patient had an attack of acute polyarthritis involving all articulations in 1872, which confined him to his bed for a period of six weeks. Has had repeated attacks now and again involving one articulation or another, for the past 40 years.

Present History.—Patient has been confined to the hospital for the past year suffering from occasional attacks of pain in all articulations, especially the knees and ankles of both legs and also severe pain on movement of muscles of lumbar region.

Objective Symptoms.—Knees and ankles of both legs are swollen, tender and crepitating; also inability to use muscles of the lumbar region when attempting to stoop forward.

Diagnosis.—Chronic progressive polyarthritis.

Course of Illness After Injection of Radium.—8-15-13. 1 P. M. Patient given 50 micrograms of radium (element) intravenously. 4 P. M. Patient given 50 micrograms of radium (element) intravenously.

8-16-13. Has less pains in bones and ankles than usual.

8-21-13. Feels generally better.

8-25-13. Swelling of both ankles has disappeared.

10-13-13. Final examination. Result—Considerably improved.

CASE NO. 16. MALE; AGE 25 YEARS. DENTIST.

Previous History.—Dates back two and one half years. Patient complains of pain and swelling affecting right ankles and knees. Had an attack of tonsilitis about one year ago.

Present History.—Has occasional pain in elbows, also pain in lumbar region.

Objective Symptoms.—Negative.

Diagnosis.—Chronic polyarthritis.

Course of Illness After Injection of Radium.—9-25-13. 100 micrograms of radium (element) given intravenously.

9-26-13. No re-action in joints.

9-30-13. Feels generally improved.

10-30-13. Final examination. Had no pain in articulations since radium was given. Result—Temporarily cured.

NOTES AND COMMENTS.

Prof. Harry C. *Jones*, of the Johns Hopkins University, delivered an illustrated lecture on "Radium and Its Properties," December 2nd, before the Natural History Society of Harrisburg, Penna.

* * * * *

A Preliminary Report on Uranium, Radium and Vanadium. Bulletin 70, Bureau of Mines, by R. B. *Moore* and K. L. *Kithil*. Washington: Government Printing Office, 1913. This report of about 100 pages gives descriptions of the Colorado and Utah carnotite deposits, and of the Colorado pitchblende deposits. The European and Australian uranium ores and the vanadium ores other than carnotite are also discussed. Methods are given for testing radio-active substances and for quantitative determinations of radium. The technology of vanadium, uranium and radium extraction is described, and analytical methods for uranium and vanadium are given. A list giving a classification and description of the minerals of uranium and vanadium concludes the report.

* * * * *

In the December number of the American Review of Reviews, an article is given on an interview with Dr. H. A. *Kelly* of Baltimore, Md., about "The Treatment of Cancer with Radium."

"Dr. *Kelly* has had an exceptional opportunity to experiment, because he has had in his possession an unusually large quantity of this precious element".

"Radium is a precious handmaid to surgery; it does not supersede it. Even if radium could cure all cases readily—and this remains to be demonstrated—we could not yet utilize the new remedy on a large scale, owing to the extreme scarcity of the element. This situation is aggravated by the fact that Dr. *Burnam* and I believe that it is only radium in comparatively large quantities that accomplishes the most satisfactory results. The movement, therefore, for early diagnosis and prompt treatment will still go on, and surgeons will still use the knife with even greater success than ever. It would, therefore, be lamentable if such success as has been attained with radium should induce patients to postpone the established methods of treatment."

"Radium gives off rays of three kinds, named alpha, beta, and gamma. These rays, however, affect non-cancerous and cancerous tissue very differently. In small quantities the gamma rays of radium penetrate good, healthy, normal tissue without producing any noticeable effect."

"These rays, however, and in these same amounts, do exercise a selective affect upon diseased tissue, such as that affected by cancer. Brought to bear upon a particular area, part of which consists of normal cells, the effect is soon apparent. The normal cells remain practically unchanged. The tumor cells show fundamental alterations. They swell, lose their characteristic appearance, break down, and are absorbed. Sometimes they seem to melt back into the normal tissues."

"The essential point is that with proper dosage they will pass through healthy tissue without bad effects, while at the same time these same quantities will destroy the cancerous tissues. Technical skill consists, therefore, in finding the dosage that will affect the sick cells without injuring the healthy."

"Now, the radium treatment does about the same thing that the surgeon's knife does. The surgeon gets rid of the cancerous tissue by cutting it out in mass; the radium gets rid of it by destroying it cell by cell."

"When the growth has widely infiltrated surrounding structures, the surgeon is often helpless. After removing the primary growth, however, he can irradiate these surrounding tissues and so have a greater chance of removing any stray cells that may be left. Radium, I believe, can thus be used to make doubly sure all ordinary operations for cancer."

"Perhaps radium's greatest triumph is in treating a particularly distressing and difficult form of cancer—that of the uterus. This and cancer of the breast are the commoner forms in which cancer chiefly attacks women, just as men suffer more from cancer of the stomach. Early operation with the knife cures this in a good many cases, but the operation is a radical one, and is not free from danger. Radium is extremely valuable in cases of this kind, as testified by experiences of the French, German, and American observers. It sometimes makes inoperable cases operable; in numerous instances radium, by itself, has established what seems to be a complete and perfect cure. Radium bids fair to establish a new era in the treatment of cancer of the uterus."

"Let me recapitulate," said Dr. *Kelly* in closing, "that there may be no misunderstandings:

1st.—Radium is not a specific cure for cancer. It does not take the place of surgery; it is another help to it. Cancer patients, in the early stages, as before, must submit to operation.

2nd.—It is most useful in cancers on the outside of the body. In many of these cases it effects cures without pain and without deformity.

3rd.—It is especially useful in connection with surgery, when it can be used to destroy vestiges of the tumor which the knife may have left behind. It can also be used to good purpose in irradiating the cancerous area preceding operation.

4th.—There are certain structures which cannot be operated on,—excised or seriously invaded,—without disastrous consequences. Radium has cured inoperable cases of this kind. It is like a microscopic knife which goes after the individual cell.

5th.—It is especially valuable in cancer of the uterus. Permanent cures even of inoperable cases have apparently been obtained.

6th.—It is effective only when there is no wide dissemination of the disease."

"What makes radium particularly useful is the simplicity of the technique. It does not necessitate the use of an anesthetic, and its administration causes no pain and almost no discomfort. The radium salt is kept enclosed in a fine platinum tube about an inch long. This tube is again encased with lead, which is used because it acts as a filter, keeping in the alpha and beta rays—which are more destructive to normal tissue—while letting the gamma rays slip through. The tube, further screened with some soft substance, is then laid in immediate proximity to the diseased part; if necessary, it can be attached by surgical plaster; in some cases incisions into the diseased part may be made as recommended by Dr. *Abbe*. Its action upon the cancerous tissues begins at once; the application lasts from 4 to 6 to 24 hours. Sometimes in a month or six weeks the growth vanishes. The radium so used can be used over and over again."

The Annual Report of the International Committee on Atomic Weights for 1914 leaves the 1913 values unchanged. Radium is given the atomic weight 226.4 (O=16.00). From analyses of radium bromide, *Hoenigschmid* finds Ra=225.97, in confirmation of his former analyses of the chloride. The discordance between this value and the higher value obtained by others is unexplained. The presumption is in favor of *Hoenigschmid's* determination, but a change in the table may well be deferred until more evidence is available.

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Dr. H. A. *Kelly* of Baltimore, Md., and Dr. Robert *Abbe* of New York, addressed the Philadelphia College of Physicians on December 15th, 1913, speaking of the treatment of cancer with the radium rays. The following statements are taken from an account of the address appearing in the Philadelphia Public Ledger: Radium is a cure for cancer. "It was not a mere announcement—ocular demonstrations were made by Dr. *Kelly*, in which he showed "positive cures" of cancerous growths. Dr. *Abbe* produced scores of plaster casts, which only recently were exhibited by him in Madame *Curie's* laboratory as a demonstration to her that radium had effected marvelous cures of diseases."

"In addition, Dr. *Kelly* stated with positive emphasis that malignant tumors may be removed as if by magic, the rays of the radium eating into the growths and causing them to disappear, in many cases, within 48 hours."

"After briefly speaking of the dangers of handling radium, Dr. *Kelly* touched upon the present supply. The speaker ended this portion of the address by declaring the United States probably would produce the greatest supply of radium in the world."

"At this point Dr. *Kelly* launched into his personal work and averred with great emphasis that the word "cure" may now be applied to this form of treatment."

"Dr. *Abbe* said that the work of Dr. *Kelly* and the few experts had dissipated the thought that cancer and tumors were incurable. He described the diseases as mere "riotous cells" which were brought back into their normal conditions and functions by the penetrating power of the radium rays."

Dr. *Abbe* has given ten years to the study, and he was one of the pioneers, if not *the* pioneer, in this country in applying radium to diseases.

"Dr. Arthur W. *Goodspeed*, professor of physics at the University of Pennsylvania, opened the evening with a paper on the radio-active properties of radium."

REVIEWS AND ABSTRACTS.

Flemming.—Experimental and Clinical Studies on the Action of Radio-active Rays in Eye Diseases. v. *Graefe's* Archiv fuer Opthalmologie. Vol. 84, pp. 345-400, 1913. (University Eye Clinic of the Charite. Prof. *Greeff*, Director).

The reports of *Cohn, Selenkowski, Darier, Uhthoff, da Gama Pinto, Birch-Hirschfeld, Falta, Thielemann, Dinger, Greiz, Neuschueler* and *Steiner, Esdra, Braunstein* and *Samkowski, Jakoby, Fortunati, Lawson* and *Davidson, Altmann, Lubarsch* and *Ostertag, Newcomet* and *Krall,*

Kardo-Sisojeff and *Muschelow* on the treatment of trachoma with the radium rays have shown very contradictory results—some finding radium remarkably effective and others finding poor results.

The workers mentioned, used quite different quantities of radium (bromide) varying from 1 to 30 mgm. Different modes of application and screening have been used, and varying intervals of application. These facts, together with the fact that trachoma in its clinical course is not well defined, make it difficult to decide whether there is any value in the use of a therapeutic agent like radium.

Little has been done with radium in other eye diseases, with the exception of the treatment of cancroid, lupus and xanthoma, in which good results were reported by *Strebel, Wichmann* and *Schindler.*

Darier obtained favorable results by the action of radium rays in the diseases of the cornea and iris, and he found the analgesic effects noteworthy. *Lawson* and *Davidson* using up to 30 mgm. of radium salt in glass tubes, with one exception found favorable results in many diseases of the cornea, corium and eye-lids. In ulcus serpens particularly good results were obtained. *Koster* and *Cath* obtained good results with radium treatment in keratitis, leukoma of the cornea, iridocyclitis, iritis, chorioiditis, blepharo-conjunctivitis, neuralgia and naevus pigmentosus, etc.

In spite of this fairly extensive literature, the action of the radium rays on the eye is far from being clearly defined. This is mainly because of the different experimental conditions used; quantity of radium, size of applicator, screening, distance from which radium acted, time of application, etc., which make the repetition of the work impracticable.

With these facts in mind the author has worked with carefully measured preparations, the action of which he first tested on normal skin (the arm), then on normal eyes (rabbit's), then on eyes which had been infected. The effect of the rays was tried on bacillus tuberculosis emulsions; on the clinical course of the disease in the eye, (a) when the eye was rayed before inoculation; (b) when the eye was rayed during the incubation period after inoculation (prophylactic raying); (c) when the eye was rayed after clinical symptoms were observed (therapeutic raying). Then the action of the radium and mesothorium rays on the normal human eye was tried, and the effects of the rays in various eye diseases.

The author worked with two applicators, one containing about 9 milligrams of radium bromide (ca. 4.8 mgm. radium element), mounted in a flat applicator 1.1 by 1.3 cm. square, screened with a thin glue layer over which was a thin layer of paraffin and an aluminum sheet 0.01 mm. thick. Due to loss of salt, and escape of emanation, this applicator was found to have a penetrating radiation corresponding to 5.8 mgm. of radium bromide, two days after it was prepared in the form indicated. 18 days later the activity corresponded to 4.8 mgm., three months later to 2.6 mgm., and about four months after that it attained a steady value equal to 1.4 mgm.

This indicated that by reason of loss of emanation, the applicator was only about 25% effective, assuming that 5.8 mgm. of the radium bromide was actually in the applicator. By tightening the covering of this applicator and thus preventing the loss of emanation, the activity was found to increase, corresponding to 4.0 mgm. of pure radium bromide. A mesothorium applicator 1.0 by 2.0 cm., containing mesothorium equivalent to 12 mgm. pure radium bromide, screened by

0.1 mm. aluminum, was also used. A uniform distribution of the radioactive material is necessary. (Note by abstractor: Better results would probably be obtained by use of a "varnish" applicator, as described by *Wickham* and *Degrais*).

The author's conclusions may be stated as follows:

Physically equivalent quantities of radium and mesothorium (by comparing gamma ray ionization currents) have equal biological effects. The distribution of radium salts determines the time required to secure a biological effect. Collected in a lump as in a tube, the effect is obtained sooner than when the salt is spread uniformly over a flat surface.

The radium applicator used, having an activity equal to 4.0 mgm. of pure radium bromide, spread on a surface 1.1 by 1.3 cm. screened with 0.01 mm. aluminum, caused an enduring pigmentation of the skin after 15 minutes' application. After an hour's application it caused a scarlike change in the skin and even after a year there developed from time to time small telangiectases.

The intensity of the biological effect on the normal skin was directly proportional to the strength of the preparation and the period of application. The incubation period, i. e. time between application and the first observation of clinical symptoms, was found to be inversely proportional to the strength of the preparation and to the period of application.

The biologic effects of a polonium (radium F) preparation (10 mgm.) even after an exposure for $1\frac{1}{2}$ hours, were of a wholly superficial nature, and limited to a reddening which disappeared after four weeks.

Microscopic investigation of the skin which had been rayed 40 days previously with the 4.0 mgm. radium applicator, showed a cicatricial cutaneous ulcer with partial degeneration of the cell nuclei, depilation, no changes in the glands or elastic fibers, no eosinophile and but few plasma cells. The healing of the rayed skin after making an excision of a piece of skin, was not smooth, in spite of joining the margins of the wound with a suture, and healing took place after slow granulation.

The normal cornea and the ocular conjunctiva of the rabbit are more resistent to radium and mesothorium rays than is the normal skin. Twenty hours direct raying of the cornea of a rabbit with the radium applicator produced a superficial keratitis which healed without a scar after the raying, while three hours direct raying with the mesothorium produced a transient superficial keratitis, and only after eight hours raying with the mesothorium were deeper ulcers and lasting scars produced.

In the experimentally produced wounds in the cornea of the rabbit, cicatrization and healing took place earlier in the rayed eye than in the control eye.

Eyes sensitized chemically by the injection of dionin showed no essential differences because of this injection either with respect to resorbtion of the infiltrate or to the action of the rays.

After the injection into the anterior chamber of the rabbit's eye of a quantitatively dosed emulsion of tubercle bacilli, it was found that the normal incubation period was increased by eight days, if the tubercle bacilli had been previously rayed at least 47 hours with the radium preparation. After 14 hours raying with the mesothorium there was no infection of the eye. The bactericidal power of the radioactive substances is slight in comparison with that of sunlight, since no infection was produced in the rabbit's eye if the t. b. emulsion was

exposed for 30 minutes to sunlight on the ground, or for 5 minutes at an altitude of 5000 to 6000 meters (where the ultra violet rays are more effective).

Raying the rabbit's eye for from 5 to 45 minutes with radium or mesothorium caused no change in the effect of a subsequently injected t. b. emulsion.

Raying the eye immediately after injection of tubercle bacilli had the effect with the radium applicator of delaying the perforation and with the mesothorium applicator of increasing the incubation period.

The normal human eye could be rayed directly for 4½ hours in intervals and 2 hours at a single time with the radium applicator, or 9¼ hours in intervals or 45 minutes at one time with the mesothorium applicator, without producing permanent disturbances.

Certain deeper ulcerative conditions of the cornea (marantic) which do not react to other agents, were quickly healed by radium rays with remarkably little opacity. In some cases of ulcus serpens there were good results, and in ulcus gonorrhoricum, keratitis eczematosa and parenchymatosa, leukoma and sclerosis there was no betterment.

In diseases of the iris the analgesic effect of the radium was noted but there was no objective improvement or shortening of the duration of the disease. Good results were obtained in the treatment of conjunctivitis chronica simplex. In some cases of trachoma the follicle retrograded with remarkable rapidity, while in other cases there was no improvement in spite of treatment for several months.

In a case of pannus with recurrent intense irritation, the raying gave very good results after all other means had failed to relieve. In the remaining cases, however, other well-known methods of treatment were found better than the ray treatment, both as regards intensity of action, shortness of the time and certainty of cure.

Tumors (cancroid, sarcoma, melanosarcoma, warts, lupus, angioma, xanthoma) as long as they were not above a certain size, were treated with extraordinarily good results. For example, sarcoma of the eye-ball which had been treated surgically without results, was completely removed in several cases, and in others the growth was so reduced during the period of observation as to lead to the expectation of a complete cure in the course of time. As it is an important property of the rays of radio-active substances to affect pathological tissues more than normal tissues, it is to be expected that radium and mesothorium rays will play an important role in the treatment of tumors of the eye, since after surgical interference disfiguring scars are usually left.

As a result of handling the radium and mesothorium applicators through a period of more than two years, without observing any particular precautionary measures, the only effect which the author noticed was the peeling off of the skin from the tip of the thumb and first finger of the right hand, which occurred every three or four weeks, a year after the experiments were begun. Aside from a sense of a numbness at times, there were no subjective effects which persisted. An excellent bibliography is given of the work in this field of radium therapy.

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Pasteau and *Degrais*, (Paris). Journal d' Urologie, Medicale et Chirurgicale, Sept. 15, 1913. Also English translation (arranged and edited by W. H. B. *Aikins*).—The Employment of Radium in the Treatment of Cancer of the Prostate, O. *Pasteau* and P. *Degrais*.—Canadian Practitioner and Review. Vol. 38, No. 12, pp. 703-729. (1913).

Prostatectomy for carcinoma, either as a palliative or as a radical operation, has given very poor results. This fact has stimulated the authors to attempt to obtain better results by radium treatment. At the outset they point out that perseverance by the surgeon and by the patient are indispensable elements in the treatment; in a number of their cases the patients disappeared from observation satisfied that they were "cured."

After analyzing the various routes along which radium could be applied, the authors decided upon a "cross-fire" between a tube of radium placed against the prostate through a perineal incision and a second tube inserted in the rectum. In this paper the authors describe only the details of the technic of radium therapy through the urethra. The results in the few cases they report are remarkable. Although in none of them was the diagnosis of carcinoma established by microscopical examination, they were all considered to be typical cases of advanced carcinoma of the prostate, in no sense operable. In the first case treatment was begun in 1911. Not only is the prostatic tumor now notably diminished in volume, but the large masses of inguinal glands are also less than half the original size. The second case, treated for one year, is even more strikingly improved. The mass of glands in the right inguinal region, at the beginning of treatment the size of a child's fist, is now almost entirely gone. In the other cases cystostomy was performed; all three demonstrated tremendous improvement, for the authors stated that the diagnosis of carcinoma could not have been made when the prostate was felt through the open bladder; all three cases were operated upon for cystitic symptoms at considerable periods after radium therapy had been applied. 50 milligrams of pure radium sulfate (35 mgm. radium element) were used in most of the cases treated and in none did the radium treatment appear to result in any harm.

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Frank E. *Simpson*: Radium in Skin Diseases. The Journal of the American Medical Association. 61, 80–83. (July 12th, 1913). A preliminary note presented to the section of dermatology of the American Medical Association at the Minneapolis meeting, June, 1913. The results presented are based on the author's experiences with radium used on forty-five patients, fifteen different skin affections being treated. Success results were obtained with radium in cases of tuberculosis verrucosa cutis, nevus pigmentosus, epithelioma, hypertrichosis, dysidrosis, neurodermititis, psoriasis, lupus erythematosus and lupus vulgaris. Improvement is being obtained in cases of angiomata blastomycosis, keloids, trichophytosis of finger nails, and lichen planus. Large flat scaly plaques of a syphilitic eruption, appearing six or seven years after the primary lesion, were treated with radium, and their disappearance followed in three weeks, although untreated lesions persisted. The discussion of this report was interesting. The use of mesothorium in place of radium was suggested, and it was poined out that mesothorium really is not cheap. (c. f. the citation on page 8 of the July number of "Radium," of a letter by Prof. Stefan *Meyer*, on this subject). The abstractor ventures to hope that in the final report of this work, that a statement will be made of the quantities of radium (element) used, the form and size of applicators, and the screening, and the time intervals of treatments, together with the number of treatments. This data is essential if the results obrained are to be compared with the results of others.

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